The Equatorial and Polar Diameters of Jupiter as measured with the Greenwich Transit-Circle, 1880–1901. By A. M. W. Downing, D.Sc., F.R.S.

In meridian transit observations the diameter of a planet may be defined as the perpendicular distance between the verticals which are tangents to the first and second limbs of the planet. This may be called the horizontal diameter at meridian passage. In the same way the vertical diameter at meridian passage is the perpendicular distance between the horizontal tangents to the north and south limbs. In the case of *Jupiter* the horizontal and vertical diameters are not generally the same respectively as the equatorial and polar diameters owing to the inclination of the planet's axis to the circle of declination.

Let P = the position-angle of the planet's axis

$$c = \sqrt{1-e^2} = \frac{b}{a} = \frac{\text{polar diameter}}{\text{equatorial diameter}}$$

$$\cot P' = \frac{\cot P}{c}, \text{ and } \tan P'' = \frac{\tan P}{c}$$

then, with sufficient accuracy in the case of *Jupiter*,

$$\text{hor. diam.} = \text{equat. diam.} \times \frac{\cos P}{\cos P'}$$

and

$$\text{vert. diam.} = \text{polar diam.} \times \frac{\cos P}{\cos P''}$$

Also let the true diameter = tabular diam. $(1+y)$, and let z be the correction to the adopted value of $\frac{b}{a}$ or c; then the equations of condition furnished by the meridian observations of diameters are:

(1) From the transit observations

$$\text{equat. diam.} \times \frac{\cos P}{\cos P'} \times y + \text{equat. diam.} \times \sin P \,.\, \sin P' \times z$$
$$= \text{observed correction to tabular horizontal diameter.}$$

(2) From the Z.D. observations

$$\text{polar diam.} \times \frac{\cos P}{\cos P''} \times y - \text{polar diam.} \times \sin P \,.\, \sin P'' \times z$$
$$= \text{observed correction to tabular vertical diameter.}$$

The variation of its coefficient is not sufficiently great to enable us to determine z satisfactorily in this way, and it seems better to adopt the value of c corresponding to the compression

of the disc of *Jupiter* deduced from the motion of the apsides of the orbit of the fifth satellite, viz. $c = \cdot 9355$, and put $z = 0$ in the equations of condition. The observations discussed in this paper have accordingly been reduced with this value of c. The adopted value of the equatorial diameter is $37''\cdot765$ at distance 5·2. The corresponding value of the polar diameter is $35''\cdot330$. The observations included in the following table are taken from the *Greenwich Observations* for the different years, and are restricted to observations made between 15 hours and 9 hours of mean time, so as to be representative of each opposition, and free from complications arising from phase, difference of brightness of background of sky, &c. The subscript figures in the fifth and sixth columns indicate the number of observations included in each mean result.

It will be noted that the observations of horizontal and vertical diameters are quite independent of each other, and are made by quite different methods ; also that the former alone are used to determine the equatorial, and the latter alone the polar diameter.

Mean Date.	Position-angle of Axis.	Tabular Diameters.		Observed Corrections to Diameters.	
		Horizontal.	Vertical.	Horizontal.	Vertical.
	°	"	"	"	"
1880 Oct. 9	336	49·17	47·06	$+1\cdot90_{24}$	$+2\cdot21_{23}$
1881 Nov. 11	345	48·77	46·07	$+1\cdot27_{28}$	$+2\cdot15_{28}$
1882 Dec. 19	359	47·49	44·42	$+1\cdot52_{20}$	$+2\cdot33_{19}$
1884 Feb. 8	13	45·07	42·44	$+1\cdot12_{19}$	$+1\cdot89_{20}$
1885 Mar. 7	23	43·84	41·83	$+1\cdot72_{28}$	$+2\cdot29_{28}$
1886 Apr. 4	25	43·32	41·54	$+1\cdot71_{24}$	$+2\cdot21_{24}$
1887 Apr. 27	22	43·84	41·78	$+1\cdot56_{24}$	$+1\cdot89_{24}$
1888 May 23	12	45·03	42·37	$+0\cdot82_{27}$	$+1\cdot98_{26}$
1889 July 3	358	46·51	43·51	$+0\cdot69_{22}$	$+2\cdot31_{22}$
1890 Aug. 9	344	47·84	45·23	$+1\cdot51_{26}$	$+2\cdot23_{26}$
1891 Sept. 30	336	47·83	45·78	$+1\cdot41_{10}$	$+1\cdot97_{9}$
1892 Oct. 14	336	49·16	46·99	$+0\cdot72_{24}$	$+1\cdot99_{24}$
1893 Nov. 27	346	48·40	45·65	$+0\cdot39_{27}$	$+1\cdot73_{27}$
1894 Dec. 31	1	47·06	44·03	$+0\cdot70_{29}$	$+1\cdot72_{29}$
1896 Feb. 13	15	44·79	42·25	$+0\cdot08_{15}$	$+1\cdot02_{15}$
1897 Mar. 12	23	43·65	41·71	$+0\cdot51_{21}$	$+1\cdot77_{21}$
1898 Apr. 8	25	43·33	41·53	$+0\cdot21_{27}$	$+1\cdot60_{27}$
1899 May 5	21	43·90	41·76	$+0\cdot88_{25}$	$+1\cdot36_{26}$
1900 May 30	10	45·25	42·51	$-0\cdot19_{22}$	$+1\cdot14_{23}$
1901 July 13	356	46·62	43·63	$+0\cdot38_{31}$	$+1\cdot40_{31}$

Combining the observations of horizontal diameter and giving equal weights to the mean results obtained for each opposition, we have

$$y = +\cdot0205 \pm \cdot0020$$

Hence the correction to the adopted value of the equatorial diameter at distance 5·2 is

$$+''\cdot774 \pm ''\cdot075$$

and the resulting value of the equatorial diameter is $38''\cdot54$.

Treating the observations of vertical diameter in the same way, we find

$$y = +\cdot0426 \pm \cdot0013$$

The correction to the adopted value of the polar diameter at distance 5·2 is

$$+1''\cdot505 \pm ''\cdot046$$

and the resulting value of the polar diameter is $36''\cdot84$.

An inspection of columns 5 and 6 of the table, however, shows that there is an apparent progressive change in the values of the observed horizontal and vertical diameters, probably due to changes in the staff of observers during the interval covered by the observations here discussed, with corresponding changes in the mean personal equation as applying to these observations.

Perhaps the most conspicuous change occurs in 1892–3; and on this account it has been considered advisable to divide the series of observations into two parts, the first extending from 1880 to 1892, and the second extending from 1893 to 1901.

Treating these partial results exactly as before, we find from the observations of horizontal diameter, 1880–1892, that the correction to the adopted value of the equatorial diameter is

$$+1''\cdot080 \pm ''\cdot067$$

and from the observations of horizontal diameter, 1893–1901, that the correction is

$$+''\cdot308 \pm ''\cdot068$$

The values of the equatorial diameter from these two series of observations are therefore

from 1880–1892	$38''\cdot84$
1893–1901	$38''\cdot07$

Similarly the observations of vertical diameter give the corrections to the adopted value of the polar diameter

from 1880–1892	$+1''\cdot700 \pm ''\cdot029$
1893–1901	$+1''\cdot209 \pm ''\cdot054$

with the corresponding values of polar diameter

from 1880–1892	...	...	...	...	37″·03
1893–1901	...	...	...	...	36·54

The results of this discussion exhibited in a tabular form are as follows :

Included Oppositions.	Equatorial Diameter.	Polar Diameter.
1880–1892	38″·84	37″·03
1893–1901	38·07	36·54
1880–1901	38·54	36·84

Report on Observations of Jupiter for 1903–4.

By Major P. B. Molesworth, R.E.

Part I. Preliminary.

Place.—Trincomali, Ceylon. Longitude east, $5^h\ 24^m\ 55^s{\cdot}6$; latitude north, 8° 33′ 24″·2. Observatory ninety-one feet above mean sea level.

Telescope.—Calver silver on glass Newtonian ; $12\frac{3}{4}$-inch aperture ; ninety-two inches focus, equatorially mounted with driving clock. The eyepieces generally employed were a Huyghenian of 230 and a Steinheil monocentric of 270.

Nomenclature.—The nomenclature I have adopted has been in use here for several years, but differs slightly from the one generally used. A diagram is given on p. 700, showing the identification of each portion of the planet. In addition to the name, a letter is allotted to each zone and belt for identification, and these are qualified by the symbols N = North, S = South, C = centre.

Scope of the Observations.—These were begun on 1903 April 21, and continued before dawn till 1903 July 30. They were continued in the evening from 1903 August 18 to 1904 February 23. They thus cover an inclusive period of 310 days, on ninety-five of which I was absent from Trincomali ; so that 215 nights were available. One hundred and forty-one of these (65·6 per cent.) were utilised, and the planet observed for central meridian transits for a total period of 287 hours ; an average of two hours four minutes per working night. Five thousand six hundred and fifty-one C.M. transits were taken, an average of nearly twenty an hour. Eight sets of measures were also made for latitude.

Colour estimations of the different belts were made on ninety-six nights. Satellite phenomena were observed on sixty-